

# 植 物 研 究 雜 誌

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### Systematic Status of the Genus *Ficus*<sup>(1)</sup>

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佐多長春：無花果屬ノ分類學の見解

The systematic status of the classical genus *Ficus* has been dealt with by many botanists like BOXBURGH, MIQUEL, GASPARRINI and KING, but apparently no recent authors discussed this problem critically from the study of the floral organ. About 26 species of *Ficus* occur wild in Formosa representing nearly all groups of the genus ever published up to the present time, and that gave a good opportunity to attack this subject to draw a satisfactory conclusion. In the course of the taxonomic study of the Formosan plants, HAYATA described 30 species of *Ficus*,<sup>(2)</sup> and some of his descriptions went into detail serving for a safe identification, but since his determination of species is mainly based upon leaf characters and other external traits, certain confusion inevitably arose. Present classification of the genus, however, has advanced to such a point that it should be based upon the internal character of the receptacles, which depends upon the nature and arrangement of various kinds of flowers sitting on the inner wall of the cavity of the receptacles, and such is more important than the external characters of the plants, like the shape and the situation of the receptacles, the habit of the plants, etc. From this point of view, the character and arrangement of flowers of all native species of the genus must be worked out to establish the sound classifi-

(1) Communications from the Horticultural Institute, Taihoku Imperial University, No. 34.

(2) HAYATA, B.: "*Ficus*" in Ic. Pl. Formos. Vol. VIII, 1919.

cation of the genus. So far as the Formosan species are concerned, the detailed study of flowers and their arrangement in the receptacles in each species have not yet been thoroughly investigated. To obtain a definite data about the sexual relationship of the flowers and the combination of flowers on the inner wall of the cavity of receptacles, the author started a botanical study of all species of *Ficus* known in Formosa, and he completed a monograph, which was published in other place.<sup>(3)</sup> In the present paper, the author wants to discuss in detail the morphological characters of the flowers and to present an explanation of the nature and the sexual arrangement of the flowers.

The *fig* flowers, which are mostly unisexual (except in the pseudo-hermaphrodite and neuter flowers), are sitting on the inner wall of the receptacles, which may be sessile or pedicellate. Five kinds of flowers found in the receptacles are as follows:—

1. The male flowers.
2. The gall flowers.
3. The fertile (or true) female flowers.
4. The pseudo-hermaphrodite flowers.
5. The neuter flowers.

In Formosan species, the male, gall, and fertile female flowers are to be distinguished very clearly, but the determination of the pseudo-hermaphrodite flowers is rather difficult, and the neuter flowers are seldom met with. The former three kinds of flowers are no need of explanation here, but the last two kinds of flowers must be studied as they play primary importance in many *Ficus* species.

Pseudo-hermaphrodite flower occurs both in a perfect or in an imperfect form, though they are hard to determine as they are easily destroyed by an unskilful technique in dissecting flowers. Such flowers have a perianth, like that of the ordinary male flowers, but along the stamen, there exists a pistil with perfect style and ovary. The author have never

(3) SATA, T.: "An Enumeration of Formosan *Ficus*." in Journ. Soc. Trop. Agr. Taihoku Imp. Univ. Taiwan (Formosa), Japan. Vol. VI, 1934.

found any ovary containing seed or pupa.

Neuter flowers are always long-pediceled and have 3-leaved perianth, without any trace of either anther or pistil.

In a discussion given to his classification of *Ficus*,<sup>(4)</sup> King says, "It appears to me that, in the peculiarities in the structure and arrangement of the flowers which I have above described, the evolutionary history of the genus *Ficus* may to some extent be traced. I have therefore ventured to arrange the Indo-Malayan species into two great groups, and to divide the second of these se-groups in three sub-groups, according to their presumed seniority. Believing that hermaphroditism is an archaic and primitive condition from which the genus is process of delivery, I look on its persistence, even in an imperfect form, as an indication of age, etc" It is self-evident that KING laid a stress upon the characters of the flowers in his classification and his system ultimately based upon the hermaphroditism principally characterized by the existence of the pseudo-hermaphrodite flowers. But the pseudo-hermaphrodite flower itself is of doubtful existence, as mentioned above, and the overestimation of this indefinite character threw his classification into an ambiguity. The author, therefore, believes that it is dangerous to use it as the basic character in dividing the genus into groups, and the starting point of such grouping must be from different character.

Effort was made to fetch the main character to divide the genus into more natural, perfect and degnite groups. The author found it more logical to lay more importance to the sexual arrangement of the flower on the receptacles rather than certain character of the flower itself, or in other words, the combination of different sorts of flowers in one receptacle is more important than the existence of certain kind of flower. The author maintains that the genus can be divided primarily according the monoeciousness and the dioeciousness of the receptacles, so that such internal structure of the set of flowers affecting the habit and the character of the receptacle, may well deserve to receive more attentive study.

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(4) KING, G.; "The Species of *Ficus* of the Indo-Malayan and Chinese Countries," in Ann. Royal Bot. Gard. Calcutta. Vol. I, 1887-1888.

The receptacle consists of hollow, flask-shaped, globose or pyriformed body, the cavity of which is lined by fleshy wall. The apex of the receptacle is terminated by ostiole covered by masses of the appressed, interlocking bracts. Minute flowers are seated on the inner wall in abundance, and the differentiation of sexes arises within the receptacle.

Strictly speaking, three cases of the structure difference of the receptacles as to the flowers do exist, but they can be first divided into two categories, i. e., the monoeciousness and the dioeciousness. The author wants to place these two kinds of receptacles, as the principal "Models" of grouping the genus. Five kinds of flowers, mentioned above, are combined in three different ways, where the flowers (1) appearing one alone (in the fertile female receptacles of dioecious species), (2) in set of a pair (in the gall receptacles or the pseudo-hermaphrodite receptacles, or also in the neuter receptacles, of the dioecious species), or (3) in set of three (in all the receptacles of the monoecious species). In explaining more fully, all species, except those included in the monoecious group (Model 1, subgenus *Urostigma*) the gall flowers occupy the same receptacle with the male (or sometimes with the pseudo-hermaphrodite flowers in place of the male) flowers while the fertile female flowers only (or very rarely associated with the neuter flowers) occupy different receptacles.

Or, in other words, the majority of the species have two distinct sets of receptacles—one set containing gall and male flowers (or sometimes the male is replaced by pseudo-hermaphrodite flowers), but no fertile female flowers, and the other set containing only fertile or true female flowers (or very rarely associated with neuter flowers) without any trace of either male or gall (or pseudo-hermaphrodite) flowers. The last arrangement, in which the receptacles are dioecious, appears in a large proportion of the species of *Ficus*, while the monoecious group (Model 1, subgenus *Urostigma*), in which male, fertile female, and gall flowers are contained in the same receptacles, but no neuter or pseudo-hermaphrodite flowers, is also found in many species of the genus.

The author believes that if the classification is primarily based upon this relation, it will be quite natural and definite. Such classification

will be summarized as follows.

Model 1. Flowers in monoecious receptacle, i. e., the receptacles are only one kind (set), never in a set of pair. In other words, male, gall, and fertile (or true) female flowers are sitting on the inner wall in the cavity of the same receptacle ..... Subgenus 1. **Urostigma** Miqu.






Model 2. Flowers in dioecious receptacle, i. e., the receptacles are always in pair. In other words, one set containing male and gall flowers (gall receptacle), or contains pseudo-hermaphrodite and gall flowers (pseudo-hermaphrodite receptacle); in the other set, fertile female flowers only are contained (female receptacle), or in the receptacle, the fertile female flowers are associated with neuter flowers (neuter receptacle).

1st. Combination: Receptacles constitutes of gall receptacle and female (or neuter) receptacle.....Subgenus 2. **Metamorphe** SATA

2nd. Combination: Receptacles constitutes of pseudo-hermaphrodite receptacle and female receptacle ..... Subgenus 3. **Palaeomorphe** (KING) SATA.

The relationship of the receptacles between monoecious and dioecious species in the genus, and the sexual arrangement of the flowers in the receptacles, above mentioned, will be illustrated in the diagrams given below.

#### Synopsis of the sign of flowers.

- |                                     |   |                   |  |
|-------------------------------------|---|-------------------|--|
| 1. Male flower                      |  | 2. Gall flowers   |   |
| 3. Fertile (or true) female flowers |  |                   |  |
| 4. Pseudo-hermaphrodite flowers     |  | 5. Neuter flowers |  |

Model 1. The plant has only one set of receptacle that contains male, gall, and fertile female flowers (Fig. 1).

Subgenus 1. **Urostigma** Mrq.

Model 2. The plant has a pair of receptacles.

Combination 1. The plant has A set and B set of receptacles.

Subgenus 2. **Metamorphe** SATA

Set A. In this set, male and gall flowers are usually found (Fig. 2).

Set B. In this set, fertile female flowers only (Fig. 3, a), or the f males are associated with neuter flowers (Fig. 3, b), are found.

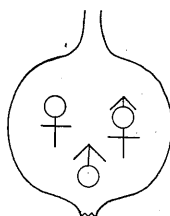


Fig. 1. Monoecious receptacle.

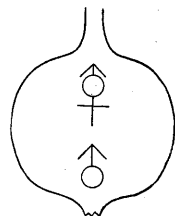


Fig. 2. Gall receptacle.

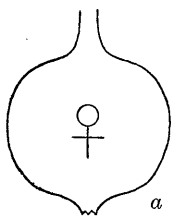


Fig. 3. Female receptacle (a) and Neuter receptacle (b).

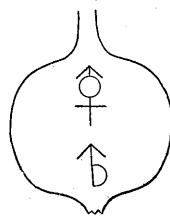
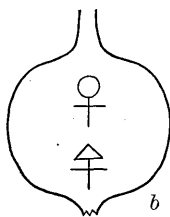


Fig. 4. Pseudohermaphrodite receptacle.

Combination 2. The plant has C set and D set of receptacles.

Subgenus 3. **Palaeomorphe** (KING) SATA

Set C. In this set, pseudo-hermaphrodite and gall flowers are usually found (Fig. 4).

Set D. In this set, fertile female flowers only are found (Fig. 5). It is questionable whether the neuter flowers occur in this set or not.

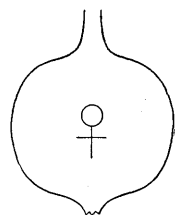


Fig. 5. Female receptacle.

In above given two models, the first, Model 1. subgenus *Urostigma*, is always the case in which their receptacles are decidedly and constitutionally monoecious, in which these three kinds of flowers (male, gall, and fertile female flowers) are always on the inner wall in the cavity of the same receptacle. This assortment is definite and unchangeable, although the vertical arrangement of these three kinds of flowers may be shifted in various species.

In the second, Model 2., there are originally two ways of combinations of receptacles but the set B and set D of the receptacles are essentially identical, the difference being in the existence of neuter receptacle in the first combination, which is not yet discovered in the second. The difference of combination 1 and 2 is therefore established by the interchange of the receptacles set A and C, or, in other words, by the presence of male or pseudo-hermaphrodite flowers.

The pseudo-hermaphrodite flowers have a stamen and perianth, like that of ordinally male flower, but along a stamen there present a rudimentary pistil which is very similar and analogous to the gall flower, especially when both organs (rudimentary pistil and gall flower) are mixed together in young stage on the narrow inner wall of the small-sized receptacles, making their identifications almost impossible.

From this point of view, the difference of the receptacles set A and C, lies in the possibility of discovering the ovary attached to the stamen in the receptacle containing the stamen and the gall flowers. Therefore, above given two combinations often becomes very obscure when the material is insufficient, so that the author made this distinction as of secondary importance, not primary importance as KING proposed.

To make clear the principle state above, the systematic groups of the genus *Ficus* are to be summarized as follows:—

Group 1.—Flowers unisexual: male flowers without rudimentary pistils.

Male, gall, and fertile female flowers on the same receptacles.

..... Subgenus 1. *Urostigma* MIQ.

A.—Receptacles axillary. Section 1. *Stilpnophyllum* (ENDL.) SATA

(1) *F. nervosa* HEYNE (2) *F. cuneato-nervosa* YAMAMOTO (3) *F.*

*cuspidato-caudata* HAYATA (4 a) *F. retusa* LINN. (4 b) *F. retusa* LINN.  
var. *nitida* KING (= *F. nitida* THUNB.)

B.—Receptacles axillary and in fascicles from stem and branches.

..... Section 2. **Gasparriniella** SATA

(5) *F. Wightiana* WALL. (= *F. infectoria* ROXB. var. *Wightiana* KING)

(6) *F. stipulosa* MIQ. (= *F. infectoria* (non ROXB.) YAMAMOTO); (= *F. infectoria* ROXB. var. *caulocarpa* KING)

Group 2.—Flowers unisexual (or asexual) or pseudo-hermaphrodite.

Subgroup I.—Flowers unisexual (or asexual): male flowers without rudimentary pistils. Male and gall flowers in one set of receptacles, fertile female flowers only (or very rarely the females associated with neuter flowers) in another set .....

..... Subgenus 2. **Metamorphe** SATA

Series I.—Flowers all asexual.

Type 1.—Flowers monandrous.

A.—Receptacles chiefly axillar ..... Section 1. **Sycidium** KING

(7) *F. antaoensis* HAYATA (= *F. hiiranensis* HAYATA) (8) *F. septica* BURM. f. (= *F. leucantatoma* POIR.); (= *F. Oldhami* HANCE); (*F. rapiformis* ROXB.); (= *F. fistulosa* (non REINW.) MATSUMURA & HAYATA); (= *F. kaukauensis* HAYATA) (9) *F. Cumingii* MIQ. (= *F. multiramea* ELM.)

B.—Receptacles mostly in fascicles from stem and branches.....

..... Section 2. **Covellia** KING

(10 a) *F. Harlandi* BENTH. (= *F. coronata* (non REINW.) SASAKI); (= *F. ochobiensis* HAYATA); (= *F. obscura* (non REINW.) MATSUMURA & HAYATA)

(10 b) *F. Harlandi* var. *kotoensis* (HAY.) SATA (= *F. kotoensis* HAYATA)

(11) *F. Konishii* HAYATA (= *F. glochidiifolia* HAYATA).

Type 2.—Flowers di-, tri-, rarely polyandrous.

A.—Receptacles chiefly axillary ..... Section 3. **Eusyce** KING

(12 a) *F. Beecheyana* HOOK. & ARN. (= *F. erecta* THUNB. var. *Beecheyana* KING); (= *F. maruyamensis* HAYATA) (12 b). *F. Beecheyana* HOOK. &

ARN. forma *koshunensis* (HAY.) SATA (= *F. koshunensis* HAYATA). (12 c)



*F. Beecheyana* HOOK. & ARN. forma *tenuifolia* SATA (13) *F. garanbiensis* HAYATA (14 a) *F. formosana* MAXIM. (= *F. taiwaniana* HAYATA) (14 b) *F. formosana* MAXIM. forma *Shimadai* HAYATA (15) *F. tannoensis* HAYATA (a) forma *angustifolia* HAYATA; (b) forma *rhombifolia* HAYATA (16) *F. vaccinioides* HEMSL. & KING (17 a) *F. foveolata* WALL. (= *F. nipponica* FR. & SAV.) (17 b) *F. faveolata* WALL. var. *arisanensis* KUDO (= *F. arisanensis* HAYATA) (18) *F. Awkeotsang* MAKINO (= *F. Nagayamai* YAMAMOTO) (19) *F. pumila* LINN. (= *F. repens* HORT. ex HOOK. f.); (= *F. Hanceana* MAXIM.)

B.—Receptacles chiefly in fascicles from stem and branches....

.....Section 4. **Neomorphe** KING

(20) *F. megacarpa* MERR. (= *F. terasoensis* HAYATA)

Series II.—Flowers may be asexual (neuter). Section 5. **Synoeccia** KING

Species not occurs definitely in Formosa.

Subgroup II.—Flowers pseudo-hermaphrodite or unisexual: male flowers with 1 stamen and a rudimentary pistil. Pseudo-hermaphrodite and gall flowers in one set of receptacles; fertile female flowers only in another set. ....

..... Subgenus 3. **Palaeomorphe** (KING) SATA

A.—Leaves usually shining and smooth: trees or shrubs.

(21) *F. caudato-longifolia* SATA (22) *F. Swinhoei* KING (23) *F. gibbosa* BL. (= *F. vasculosa* (non WALL.) MATSUMURA & HAYATA); (= *F. rigida* BL.); (= *F. cuneata* BL.).

B.—Leaves scabrous: trees and shrubs.

(24) *F. Kusanoi* HAYATA (= *F. Somai* HAYATA) (25) *F. Kingiana* HEMSL. (26) *F. Hayatai* SATA (= *F. gibbosa* (non BL.) HAYATA); (= *F. rigida* (non BL.) SASAKI).